Carrots

ATLANTIC PROVINCES VEGETABLE CROPS GUIDE TO PEST MANAGEMENT 2002 - 2003

Prince Edward Island
CANADA
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Introduction

Carrots *(Daucus carota)* and parsnips *(Pastinaca sativa)* belong to the Umbelliferae (the carrot family). This family includes other vegetables such as celery, celeriac, parsley and several herbs. Both carrots and parsnips originated in the Mediterranean area and were in use over 2000 years ago (carrots, also known as Queen Anne's Lace, in Southeast Europe and Afghanistan - parsnips, in central and southern Europe). Both are botanically biennial plants which were first used as medicines and then became popular as food crops - parsnips in the 16th century in Europe and the orange carrot in the 17th century in Holland. The edible part of these plants is an enlarged taproot.

Carrots are grown in the tropics where high elevations give cool night temperatures and in temperate regions of the world. Optimum growing temperatures for these crops are 15° to 20°C with a minimum of 5°C and a maximum of 24°C. The minimum temperature for germination is 2°C with an optimum range of 10° to 25°C. The optimum germination temperature for parsnips is 18°C and carrots is 25°C. The maximum temperature for germination is 30°C and 35°C respectively. These crops therefore favor cool season conditions. Low and high temperatures reduce seed germination. Both carrot & parsnip foliage are hurt by frosts (1.5°C) but this does not usually affect the roots. When there are freezes for over 24 hours, the crowns can be

injured and these carrots will not keep well. Adequate moisture is necessary for good yields and quality. Parsnips usually overwinter well on sandy well drained soils. When seedlings with roots 6 mm in diameter or larger are subjected to cold temperatures (below 10°C) for a period of time flower initiation takes place. For early seeded carrots of susceptible varieties, bolting may occur.

A deep well aerated soil, free from stones and well supplied with moisture is required for the development of long smooth roots. Well drained sandy loam and organic soils are preferred. Seed germinates over a 2 week period or is restricted if a crust forms on the soil surface. The earliest seeds to germinate produce the largest roots. The seed bed also has to be prepared free of clods since hilling of cylindrical varieties is required late in the season to prevent greening or "sunburn". Planting on hills also increases the length of carrots. Soil compaction affects root growth and length. In compacted soil the taproot is conical in shape and the root is usually heavily furled. Do not over work soils or work them when wet. Soil compaction at harvest is extreme due to the heavy equipment, especially if the soil is wet.

Carrot harvest begins with the bunched crop in mid July. Roots for packaging are harvested starting in early to mid August. By the first of September carrot harvest is intensifying. By mid September harvesting of the storage and processing crops is in full swing. Carrots harvested from mid September to November yield a gross weight of 40,000 to 80,000 kg per hectare. Marketable yields average 25,000 kg per hectare (fresh or processed).

Parsnip harvest usually begins in mid September for fresh market and storage although some hand harvest may be done for roadside market sales in early September. Parsnip yields are over 20,000 to 30,000 kg per hectare.

Carrot production in the Atlantic area is important due to a large fresh market and processing industry. It is a crop with a high per capita consumption and there appears to be some potential for increased consumption of both fresh and processed products, eg. fresh peeled baby carrots. Parsnip consumption in this area is traditionally high and it is not anticipated there will be much increase in this market. Carrot growers usually produce some parsnips to make up truckloads and hopefully increase overall profits.

There may be some markets for specialty crops such as baby carrots (fresh and processing), large carrots for HRI trade, and parsnips for processing.

Nutrient Content of Carrots: One of our best sources of Vitamin A. One medium raw carrot supplies our daily requirement of this nutrient. It also contains other vitamins and minerals including potassium. 1 raw carrot contains 20 kilocalories. 250 mL (1 cup) cooked carrots has 47 kilocalories.

Nutrient Content of Parsnips: Good source of calcium, potassium and folate. Contains small amounts of other nutrients including Vitamins A and C. A 250 mL (1 cup) serving of cooked parsnips contains 186 kilocalories.

Crop Establishment ▲ to Top

Seed Treatment - Both pelleted and raw seed are used in precision seeders since the advent of the air seeder. High quality seed is essential for good germination and seedling vigor. Various seed treatments and coatings can be applied to raw seed. See the Atlantic Provinces Guide to Pest Management for details. Also "primed" seed is available for sale.

Seeding/Planting - Sow as early as the soil can be properly prepared. This is usually late April or early May. Soil moisture levels then are usually higher, there are fewer problems with crusting and generally better stands result from early seedling. Late seeded crops may burn off if they emerge during hot dry weather, or the soil may cap and not allow emergence.

The seeding depth should not exceed 0.6 to 1.2 cm. Deeper planting results in uneven or no germination.

The approximate seeding rate for carrots is 2 to 4 kg per hectare (raw seed) and 3 to 5 kg per hectare for parsnips (raw seed). Seed in single rows or bands 10 cm wide, 60 to 70 cm apart or in beds of 3 or more rows 15 to 45 cm apart depending on the minimum required by the plants or the planting and/or harvesting equipment. Space carrots at 40 to 75 per metre of row and parsnips 25 to 35 per metre of row depending on the soil type and row width. Higher plant populations require more water and fertilizer and reduce average root size. The closer plant spacings should be used on peat soils.

Crop Management ▲ to Top

Cultivation should be kept to a minimum to reduce root pruning.

Hilling will reduce green shoulders on susceptible varieties.

Remove bolters in fields of carrots destined for slicing (processing) if necessary.

Nutrition ▲ to Top

ALL ADDITIONS OF LIME AND FERTILIZER OR MANURES SHOULD BE BASED ON RECOMMENDATIONS FROM A SOIL TEST.

Carrots in research trials on fertile mineral soils in the Atlantic area have shown little response to application of N, P and/or K fertilizers. The use of fresh manures in the spring has not led to any problems with forking of roots and has increased grower yields.

Lime - Limestone should be applied to maintain the soil pH in the range 6.0 to 6.8. Parsnips are more sensitive to acid soils than are carrots. Gypsum may be used on coarse sands where calcium levels are low and the pH is quite high. This is in order to increase both soil calcium and sulfur levels.
Magnesium deficiency may occur where dolomitic limestone has not been used. Mg0 may be included in the fertilizer but it is usually most economic to use dolomitic limestone.

Nitrogen - Application is usually made at the time of seeding but the crop is often sidedressed in July, August or September if it appears the top growth will not be sufficient for effective harvesting. Research results do not indicate a yield response to applied nitrogen. Individual recommendations must be made for those growing on organic soils. On parsnips excessive nitrogen may encourage foliar diseases.

Phosphorus - Apply phosphorus to maintain reasonable soil levels of this nutrient. Usually this is broadcast and incorporated before planting.

Potash - Crops may respond to potash if it is low. Maintenance levels of potash are usually applied by growers. This is the soil nutrient removed in highest amounts by large crops of carrots.

Micronutrients - Apply some *boron* in the fertilizer (.2 to .3B) or apply Solubor to the soil before planting or as foliar sprays. *Boron, copper and molybdenum* must be applied on peat soils. Apply copper sulphate (50 kg per hectare) and sodium or ammonium molybdate (5 kg per hectare). Copper deficiency is also possible on mineral soils. This can result in poor orange color and skin discoloration on fresh market carrots.

Application Method - Generally nitrogen, phosphorus, potash, calcium and magnesium are broadcast and incorporated before planting if efficient banding equipment is not available; nitrogen is broadcast if necessary. High rates of commercial fertilizers and manures applied preplant will greatly reduce germination. If high rates are felt to be necessary broadcast the phosphorus and part of the nitrogen and potash. Then sidedress the balance of the nitrogen and potash later in the growing season.

Pests and Pest Control ▲ to Top

Weeds

Perennial weeds should be controlled prior to planting. Preemergence herbicides usually provide good weed control. Carrots can be severely injured by preemergence herbicides when heavy rainfall or a high water table coincides with carrot emergence. Post-emergence treatments are also available for annual broadleaf weeds and grasses. However the stage of crop and weed growth is critical for good control with no crop injury.

Remove by hand small numbers of weeds that may escape herbicide treatment to reduce future weed potential. Also, carry out a good crop rotation to reduce the general reservoir of weed seed in the soil.

Diseases

Leaf Spots and Blight (fungi)

Characteristics: *Cercospora* leaf spots are brown to gray and circular. *Alternaria* blotches are irregularly shaped brown to black and more prevalent on older foliage.

Both are seed and soil borne, can be spread by wind, rain splash and farm implements but will only infect leaves when they are wet.

Control: Apply sprays at 7 to 10 day intervals starting the first week of July or if fields are checked regularly then when disease is first detected. Continue spraying until 3 weeks of harvest. Spray intervals can be increased if there is no rainfall and night temperatures are cool (minimum temperature below 15°C). Processing carrot growers usually try to minimize spray applications to minimize costs. Follow a 2 to 3 year rotation and plow down carrot debris promptly following harvest. Storages and crates should be disinfected. Poorly timed irrigation can aggravate these diseases.

Gray Mold (Botrytis) and Sclerotinia White Mold (fungi)

Characteristics: Both fungi produce decay on stored carrots. The former has a gray "fuzzy" appearance while the latter produces white cushions of mycelium which may contain hard black pea-sized fungal structures.

Control: Plant on a well-drained soil not recently used for soybeans, alfalfa, beans, lettuce, peas, tomatoes, carrots or cabbage. Practice a 3 year rotation. Store carrots at 0°C with a relative humidity of 95 to 98%. Control weeds and "bolters" as they may spread white mold and Botrytis by means of infected flower parts falling on healthy carrot plants.

Root Knot (nematodes)

Characteristics: Carrots may have forked roots, irregular round galls and spindle-shaped enlargements on tap and side roots.

Control: Where root-knot nematodes are a problem soil can be fumigated. Rotation or summer fallowing will reduce nematode numbers considerably.

Aster Yellows (mycoplasma)

Characteristics: Yellowish, dwarfed leaves, usually forming a tight rosette. Older leaves may develop reddish margins. The root at the crown may bulge up into a cone and many hairlike roots develop on the root. The mycoplasma overwinters in many perennial weeds and is spread by leafhoppers.

Control: Destroy weeds in fields, headlands, ditch banks, fence rows, etc. Avoid planting near susceptible crops. See leafhopper control.

Parsnip Diseases

(Itersonilia) Canker or Blight (fungus)

Characteristics: Leaf spots appear as small silvery areas which later enlarge to brown irregular shapes with indistinct dark borders. Cankers are most prevalent near the shoulder of the root; they begin where rootlets are attached to the taproot. Affected areas are first brown to reddish-brown, later becoming black as cankers develop and

as affected areas become depressed. The fungus overwinters in diseased plant residue. Disease is worst in cool wet conditions.

Control: Apply five sprays at 7 to 10 day intervals beginning the first of August. In addition to spraying, beneficial results are obtained by gradually hilling the rows. Every 10 to 14 days add a small amount of soil to the ridge until the rows are well covered.

Insects

Carrot Rust Fly

Characteristics: The adult is shiny black, with pale yellow head and legs. It is less than 5 mm in length. Damage is caused in feeding by yellowish-white, legless maggots which are 8 mm long when fully grown. Attacks result in stunting of carrot and parsnip plants. Roots may be reduced in size or distorted, scarred and riddled with rust-red burrows of the larvae. Seedlings may be killed if the growing tips are severely injured. Adult flies appear twice, in early summer and mid August, and lays eggs, which hatch 6 to 12 days later into larvae. Adults start at field margins increasing risk of damage in these areas. Small sheltered fields and poor rotational practices increase the chances of rust fly injury. This insect is a weak flier and does not do well in a windswept field.

Control: Follow a good crop rotation. Do not plant in fields adjacent to last years carrot crop. Where a known population exists chemical controls should be applied at planting. Planting may also be delayed until after mid-June to avoid the first generation of flies. Carrots may be harvested early (in late August or early September) before the maggot leaves the hair roots and enters the main tap root. Individual fields should be monitored using orange sticky traps to determine if control measures are necessary. Place traps in sheltered areas of the field, along the field edge. Apply spray when adult flies are first caught in the traps. Polyester or other fabric covers that exclude this fly could be applied on small fields. Do not allow holes to develop in the material or control will not be obtained. Row covers have not been researched in this area and may aggravate foliar and root diseases.

Aster (Six-spotted) Leafhopper

Characteristics: . They are small (4 mm long), slender, wedge-shaped insects. They are greenish-yellow in colour. They feed on many other crops such as potatoes, tomatoes, celery, spinach, lettuce, onion and squash. Adult leafhoppers winter in weedy areas along the margins of fields. They generally move into carrot fields early in July. Leafhoppers can carry aster yellows from plant to plant as they feed Once a leafhopper feeds on an aster yellows infected plant, it can spread the disease to all the other plants it feeds on.

Control: Foliar sprays are required beginning the first week of July and repeated at 10 day intervals until the end of August. Spray field boundaries also. Fields can be monitored using a 30 cm diameter sweep net. Five samples of 25 sweeps along the row are taken and the average number of leafhoppers determined. The threshold for

applying a spray is 5 leafhoppers per sample. It is important to control leafhoppers early in the season to prevent the build up of aster yellows.

Carrot Weevil

Characteristics: Adult carrot weevils are dark brown with three light stripes on the thorax. They are about 6 mm long. The head is prolonged into a beak or snout. The adults overwinter in the sheltered margins of fields. They lay their eggs in carrots when the plants are at the second true leaf stage. The larvae are white legless grubs. They feed on the carrot tap root. Usually damage is restricted to the upper third of the root. There is only one generation per year known to occur in this area.

Control: Follow a good crop rotation. Do not plant in fields adjacent to last years carrot crop. Carrot weevil traps can be used to determine the need to apply a control measure. The threshold for a single spray at the second true leaf stage is 1.5 to 5.0 weevils per trap. If the cumulative number per trap exceeds 5.0 then a second application is needed at the four leaf stage.

Damage from this insect has not generally been significant. Good rotation may keep it from becoming a major problem.

Harvesting and Handling ▲ to Top

Careful handling to avoid bruising, cutting and breakage will help ensure successful storage and high percentage pack out. Carrots should be cooled to below 5°C promptly after harvest using forced-air or hydrocooling.

Storage and Conditioning ▲ to Top

Desirable storage conditions are a temperature of 0°C with a relative humidity of 98 to 100%. Mature carrots should keep 5 to 6 months under these conditions. Rapid cooling of carrots after harvest is important to reduce storage rots. Storage rots usually occur through disease infections in the field or through wounds at harvest. Proper sanitation of storage and handling equipment is necessary to help reduce infections. Immature carrots harvested for the fresh market will store for 4 to 6 weeks. Bunched carrots may be kept 10 days to 2 weeks at 0°C if the humidity is kept high. Constant icing is effective to keep the tops fresh. Do not store carrots with apples or other fruits, as ethylene gas given off will induce a bitter flavor in the carrot root.

Storage conditions for parsnips are similar to those for carrots. Good market quality is the result of starch changing to sugar which occurs after 2 to 3 weeks in storage below 1°C. It is not necessary to leave parsnips out over winter or to freeze them. Because parsnips are susceptible to wilting, humidity must be kept high. Maintaining sufficiently high humidity may be a problem, particularly in cold storage, with both carrots and parsnips. Ventilated plastic crate liners help to prevent moisture loss. For information on high humidity vegetable storages, contact your provincial vegetable specialist.

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(See also General References)

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PEST	PESTICIDE (Formulation)	RATE Product	DAYS TO HARVEST	REMARKS
Weeds ▲ to Top				
Preplant Perennial Weeds including quackgrass	ROUNDUP 356 Sn	2.5 to 7.0 L/ha	-	Apply in the fall or spring prior to planting. Annual weed control programs will be necessary to control weeds germinating after planting. For quackgrass control apply to actively growing quackgrass when at least 4 new leaves are present. The low rate (2.5 L/ha) will provide a minimum of one season control, while higher rates (4.75 to 7 L/ha) will provide longer term control. The low rate of Roundup should be applied in 50 to 100 L/ha water. If higher water volumes are used add a suitable surfactant. Wait 72 hours before plowing under. Best control of quackgrass is obtained when these herbicides are applied in the fall.
	TOUCHDOWN 480	2.5 to 7.0 L/ha	-	
	GLYFOS	2.5 to 7.0 L/ha	-	
	ROUNDUP TRANSORB	2.5 to 7.0 L/ha	-	
Preplant Incorporated Treatments	trifluralin:		-	Lightly incorporate, 8 to 10 cm depth within 8 to 24 hours of application following label instructions. Ragweed and mustards are not controlled. Corn or cereal grains may be injured when planted in fields
	BONANZA 400	1.5 to 2.75 L/ha	-	

Germinating annual grasses and some broadleaf weeds	RIVAL 60 DF	1.0 to 1.9 kg/ha	-	treated with trifluralin the previous year. Mineral soils only. Use in conjunction with postemergence herbicide.
	TREFLAN 480	1.2 to 2.3 L/ha	-	
Preemergence Treatments Annual Weeds	AFOLAN F 480	1.3 to 1.9 L/ha	-	Should be applied soon after seeding. Use lower rate on sandy soils. Carrots are sensitive at time of emergence and heavy rains or irrigation following treatment may result in injury.
	LOROX 50 DF	1.1 to 3.25 kg/ha	-	
	GESAGARD 80 WP	2.25 to 4.25 kg/ha	-	Should be applied soon after planting. Do not use at or near time of emergence.
Preemergence followed by Postemergence Germinating Annuals and Emerged Weeds	AFOLAN F 480 followed by AFOLAN F 480	1.3 to 1.9 L/ha 1.9 to 2.5 L/ha	-	These treatments must be at least 2 weeks apart. See preemergence and postemergence remarks above.
	LOROX 50 DF followed by LOROX 50 DF	1.1 to 2.25 kg/ha 2.25 to 4.5 kg/ha	-	
	GESAGARD 80 WP followed by LINURON:	2.25 to 4.25 kg/ha	-	On organic soils, a combination procedure which has been successful is to use the pre-emergence prometryne treatment followed by a postemergence linuron treatment as required. Carrots to be exported to the U.S. should not be treated with Gesagard.
	LOROX 50 DF	1.1 to 3.25 kg/ha	-	
	or AFOLAN F 480	1.3 to 2.3 L/ha	-	
Postemergence Treatments Annual Weeds	HERBICIDAL OIL (Weedkiller No. 1)	600 to 800 L/ha (overall spray) 300 to 400 L/ha (rows only)	30	Apply undiluted. Apply as soon as true leaves develop but before carrots are thicker than a pencil. Later treatments may result in an oil flavor in carrots. Weeds should be less than 10 cm high.
	AFOLAN F 480	1.9 to 4.7 L/ha	-	Apply after carrots are 8 to 15 cm high. Temporary yellowing of carrot leaves may occur. If a pre-emergence treatment of a linuron product was used reduce the postemergence treatment to 0.8 kg/ha (active).
	LOROX 50 DF	2.25 to 4.5 kg/ha	-	
Stale Seedbed Technique	REGLONE L	2.7 to 5.5 L/ha	-	Apply before crop emergence to foliage of emerged weeds. Read label for water volumes required per hectare.
	GRAMOXONE L	2.7 to 5.5 L/ha	-	
	GRAMOXONE	2.0 to 4.0 L/ha	-	
	IGNITE 15 Sn	2.7 to 5.0 L/ha	-	

Annual Grasses	HOE-GRASS 284 EC	3.5 L/ha	-	Apply when grasses are in 1 to 4 leaf stage. Do not tank mix with other products. Does not control quackgrass.
	EXCEL SUPER 80.5	0.67 L/ha	90	Apply when annual grasses are actively growing in the 1 to 6 leaf stage.
Quackgrass and Annual Grasses	FUSILADE II (125)	0.60 to 2.0 L/ha	50	Apply when crop is 10 cm in height or less. Use the high rate for quackgrass control. Do not tank-mix with other herbicides.
Insects ▲ to Top				
Aster leafhopper		Action Threshold		5 leafhopper adults/25 sweeps. See Publication 1400 for further details on monitoring.
	SEVIN SL 420 SU	1.2 to 2.5 L/ha	1	Apply when leafhoppers first appear and repeat when the Action Threshold is reached. Otherwise apply at 7 to 10 day intervals until the end of August or 20 days before harvest for early carrots.
	SEVIN 85 WP	2.0 kg/ha	1	
	SEVIN 80 SP	1.5 kg/ha	1	
	SEVIN 50 WP	3.5 kg/ha	1	
	SEVIN XLR 43 SU	1.25 to 2.5 L/ha	1	
Carrot rust fly (2nd generation)		Action Threshold		For fresh market carrots 0.1 flies/trap/day. For processing carrots, 0.2 flies/trap/day. See Publication 1400 for further details on monitoring.
	DIAZINON 50 WP	1.1 kg/ha	10	Apply in 550 L of water with no more than 3 applications per season.
	DIAZINON 500 EC	1.1 L/ha	10	
	CYMBUSH 250 EC	280 ml/ha	35	
	DZN 600EW	915 mL/ha	10	
Carrot weevil		Action Threshold		1.5 to 5.0 weevils/trap, (cumulative value) spray at two leaf stage.
	IMIDAN 50 WP	2.25 kg/ha	40	Use up to 1000 L/ha. Do not apply more than twice per year. **Imidan should not be used on carrots that will be shipped to the USA either as fresh or processed.**
Cutworms	LORSBAN 25 WP	4.5 to 9 kg	60	Apply when cutworms are noticed. 1 application per season.
	LORSBAN 4E	2.4 to 4.8 L ha	60	
	PYRIFOS 50 WP	2.25 to 4.5 kg/ha	60	
	RIPCORD 400 E	175 ml/ha	21	Spray under warm, moist conditions. Do not disturb soil for 5 days.
Diseases ▲ to Top				
Cavity Spot	RIDOMIL 2G	25 kg/ha	at planting	Apply in the seed furrow at the time of planting. Make only one application per year. Refer to the label for further information.

Aster yellows disease	-	-	-	SEE ASTER LEAFHOPPER IN INSECT SECTION.
Leaf spots & blight	BRAVO 500 F	2.4 to 3.2 L/ha	1	Apply at 7 to 10 day intervals beginning when disease is observed. Do not grow carrots successively in the same field.
	DITHANE 75 DG	2.25 kg/ha	7	
	PENNCOZEB 75 DF	2.25 kg/ha	7	
	DITHANE M-45 80WP	2.25 kg/ha	7	
	MANZATE 200 80WP	2.25 kg/ha	7	
	MANZATE 200 75 DF	2.25 kg/ha	7	
	MANEB 80 WP	1.1 to 3.25 kg/ha	5	
	DITHANE M-22 80 WP	1.1 to 3.25 kg/ha	5	
	ZINEB 80 WP	1.1 to 3.3 kg/ha	7	
	POLYRAM 80 DF	2.25 kg/ha	7	
Sclerotinia white mold	BENLATE 50 WP	0.25 to 1.1 kg/ha	15	Apply at the first sign of disease and repeat at 7-10 day intervals. Do not apply more than three times per season. For canning carrots only. Practice a 3 year rotation with non-susceptible crops.